A Web Services Framework for Collaboration and Videoconferencing

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PTLIU Laboratory for Community Grids

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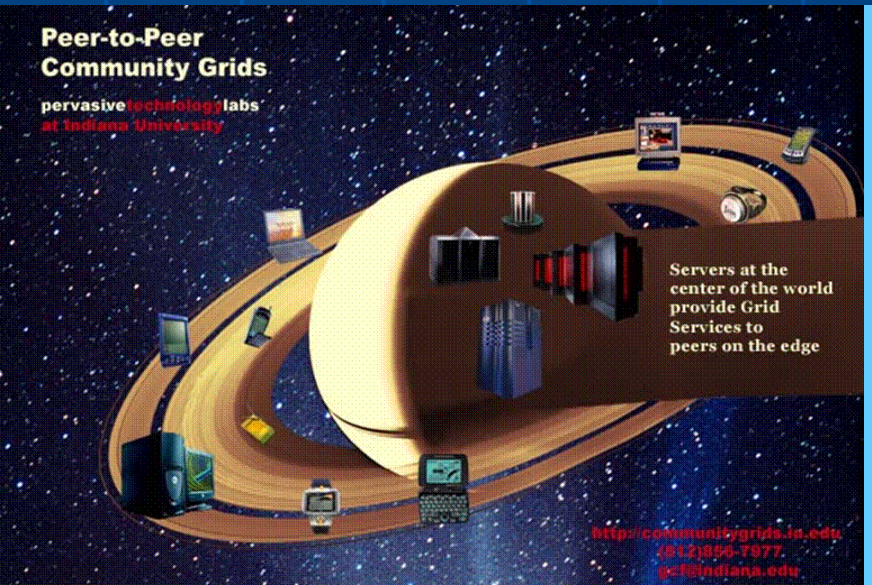

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Abstract

- We define such a common, interoperable framework called XGSP (XML based General Session Protocol) based on Web services technology for creating and controlling videoconferences
- We developed a common dynamic messaging environment (NaradaBrokering) for the collaboration applications
- Based on the web-services framework and NaradaBrokering messaging environment, we are developing Global Multimedia Collaboration System (Global-MMCS)

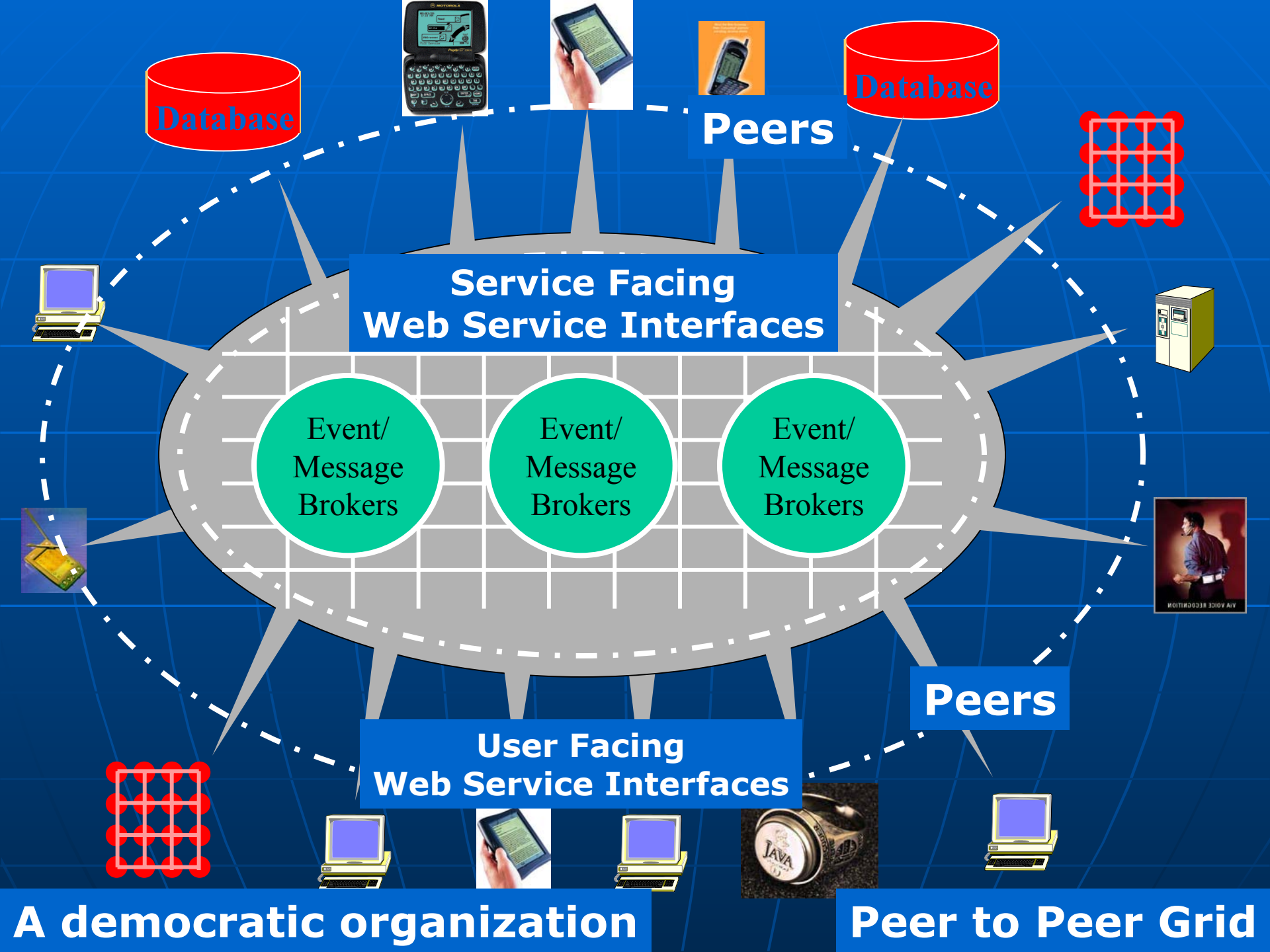
  Integrates various services including videoconference, instant messaging and streaming, and supports multiple videoconferencing technologies and heterogeneous collaboration environment.

Collaboration and Web Services

- Collaboration has
  a) Mechanism to set up members (people, devices) of a "collaborative sessions"
  b) Shared generic tools such as text chat, white boards, audio-video conferencing
  c) Shared applications such as Web Pages, PowerPoint, Visualization, maps, (medical) instruments ….
- b) and c) are "just shared objects" where objects could be Web Services but rarely are at moment
  - We can port objects to Web Services and build a general approach for making Web services collaborative
- a) is a "Service" which is set up in many different ways (H323 SIP JXTA are standards supported by multiple implementations) – we should make it a WS

Shared Event Collaboration

- Collaboration involves **sharing resources** and synchronous collaboration involves **coordinating a common view of a resource between multiple clients**
- All collaboration is about sharing some sort of event
  - **Audio/Video conferencing** shares events specifying in compressed form audio or video
  - **Shared display** shares events corresponding to change in pixels of a frame buffer
  - **Instant Messengers** share updates to text message streams
  - **Microsoft events** for shared PowerPoint (file replicated between clients)
- Using Web services makes universal as exposes updates of all kinds as messages
- Group communication service is needed for the delivery of the update events
  - Using Event Messaging middleware makes messaging universal


Database
Database
Peers
Service Facing
Web Service Interfaces
Event/
Message
Brokers
Event/
Message
Brokers
Event/
Message
Brokers
Peers
User Facing
Web Service Interfaces
A democratic organization
Peer to Peer Grid

Solutions to Problems from current collaboration systems

- **Networks were unreliable and firewalls are a problem**
  - **Not a lot of progress with QoS at network level**
  - **Some QoS problems are due to different collaboration streams interfering**
  - *Use application level QoS with highly robust managed messaging*
- **Many different standards H323, SIP, Access Grid, T120 …**
  - *Unify as single XML standard*
  - *Make the conference control services into Web Services*
- **Very hard to customize each application in "shared state event model"**
  - *Offer shared display*
  - *Convert Applications to Web Services*
- **Inconvenient to customize user interfaces**
  - *Use portlet technology supporting desktop and PDA clients*

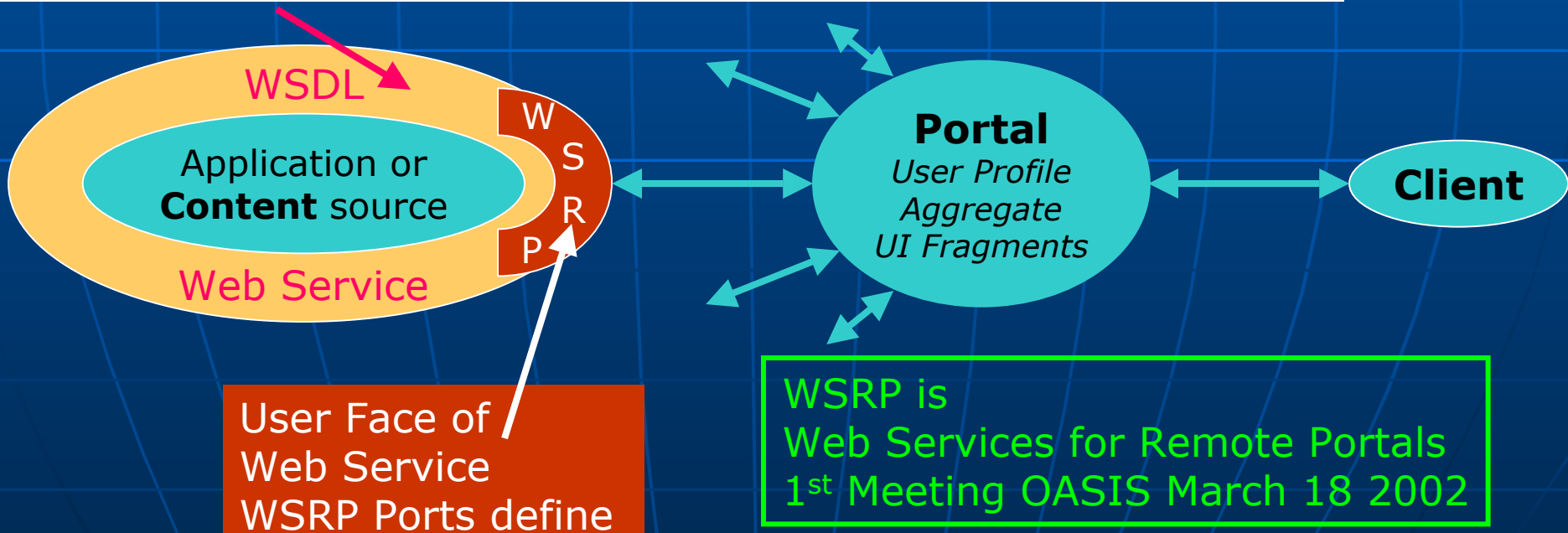
Portals and Web Services

- **Web Services allow us to build a component model for resources.**
- **Each resource naturally has a user interface (which might be customized for user)**
- **Web Service <--> Portlet**
- **Natural to use a component model for portal building displayed web page from collection of portlets**
  - **So can customize each portlet and customize which portlets you want**

WSRP Structure of a Portlet

- Each Web Service naturally has a user interface specified as "just another port"
- This gives each Web Service a Portlet view specified (in XML as always) by WSRP (Web services for Remote Portals)
- So component model for resources "automatically" gives a component model for user interfaces
  - When you build your application, you define portlet at same time

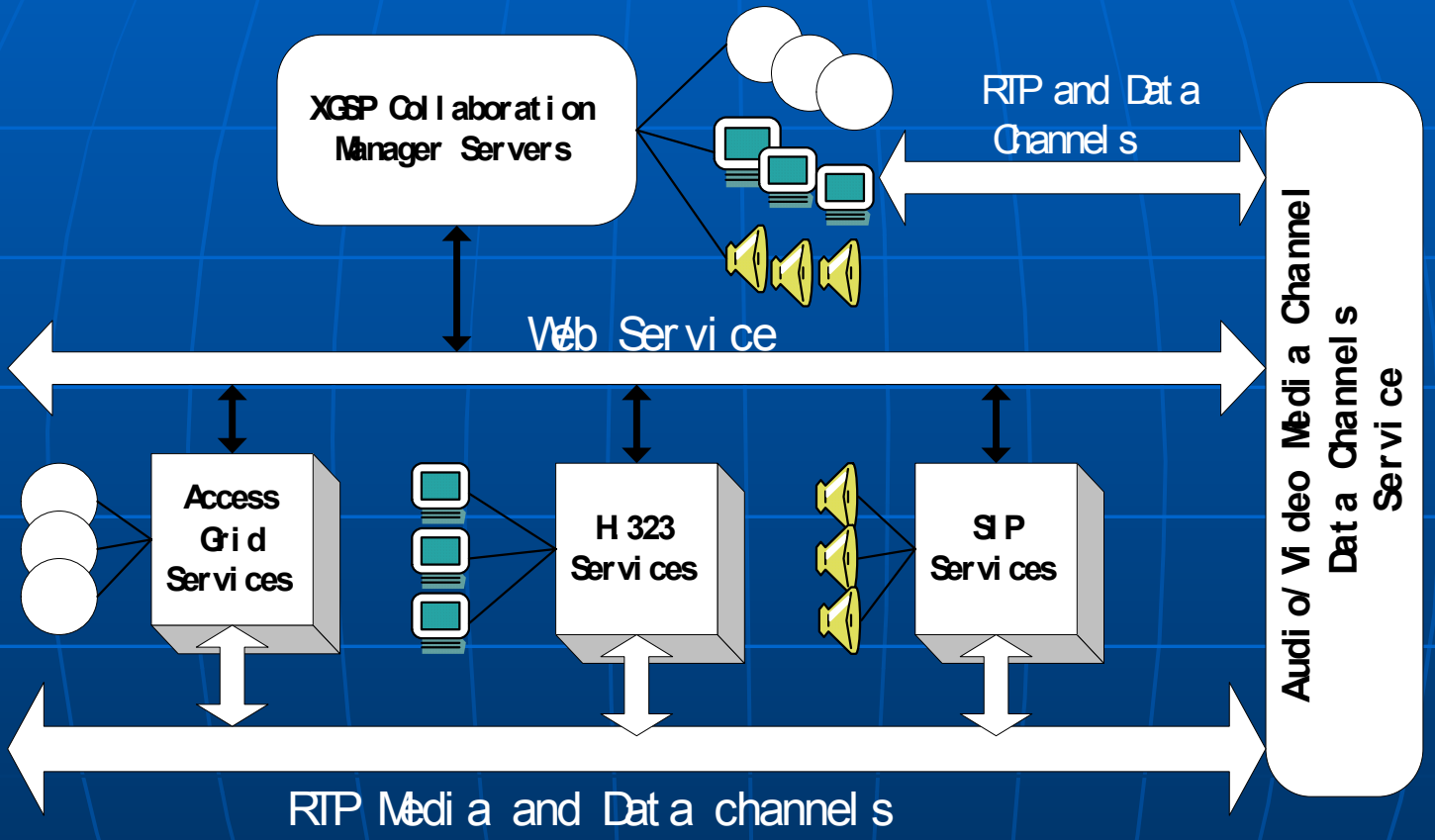
Application as a WS
General Application Ports Interface with other Web Services

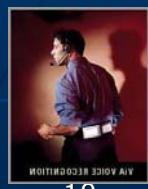


XGSP Framework

- To integrate heterogeneous systems into one collaboration system, we need to reach the following goals:
- (1) Different kinds of application endpoints should join leave in the same collaboration session.
- (2) Different providers for multipoint A/V and data collaboration should be connected together to build unified A/V and data multipoint channels.
- (3) A common user interface should be present for all the collaboration participants using different A/V and data application endpoints.

XGSP Conference Control Framework





XGSP Conference Control Framework Components

- **User session management**
  - User session management supports user sign-in, user create/terminate/join/leave/invite-into XGSP sessions.
- **Application Session Management**
  - XGSP application session management provides the services to A/V and data application endpoints and communities, controlling multipoint A/V RTP and data channels.
- **Floor Control**
  - Floor control manages the access to shared collaboration resources.

XGSP Application Session Management

- **XGSP signaling protocol for**
  - **H.323 signaling protocols (H.225, H.245)**
  - **SIP signaling protocol (Invite, Bye Message)**
  - **Access Grid (Unicast VIC & RAT)**

  Join XGSP Session, Leave XGSP Session,

  Invite into XGSP Session, Expel from XGSP Session
- **Activate the XGSP session**
  - *the XGSP session server will link all the "rooms" in the session together by connecting multipoint A/V and data channels from different communities to the XGSP A/V Media and Data Channel Services.*

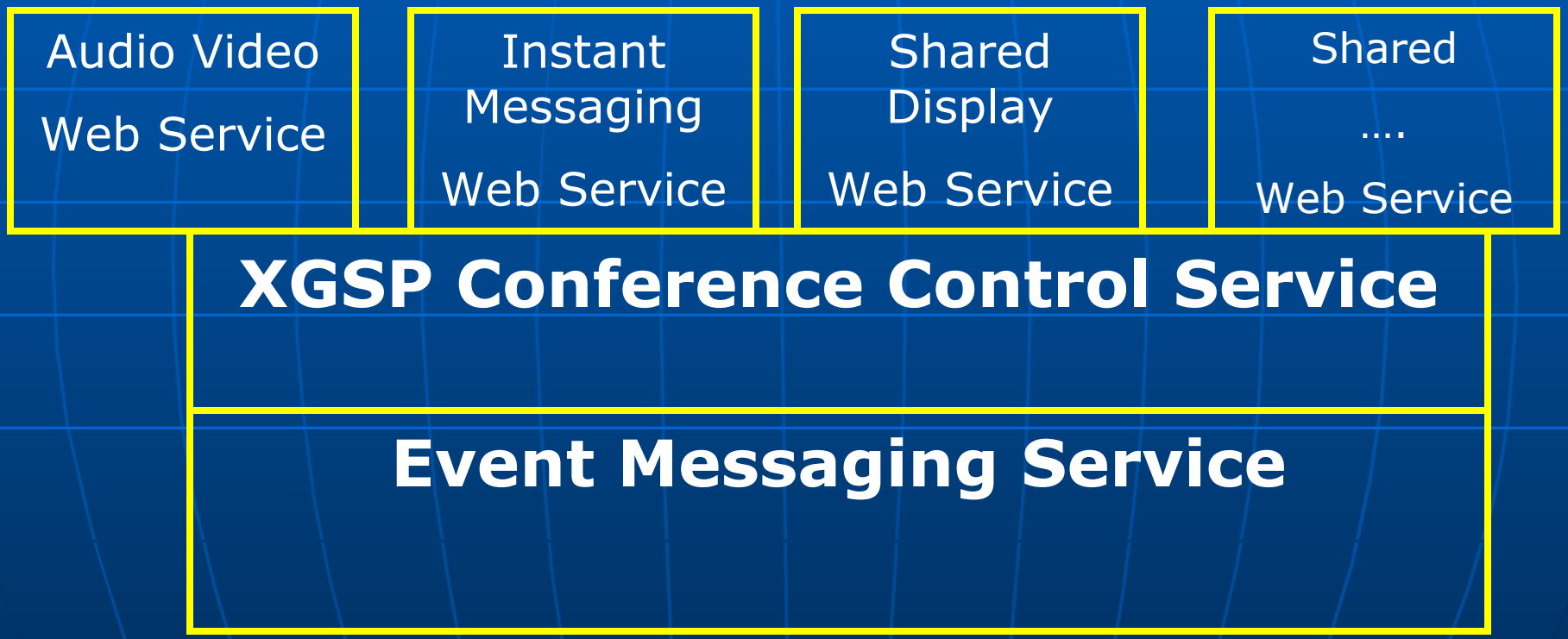
  Link/Disconnect XGSP SubSession

XGSP Floor Control

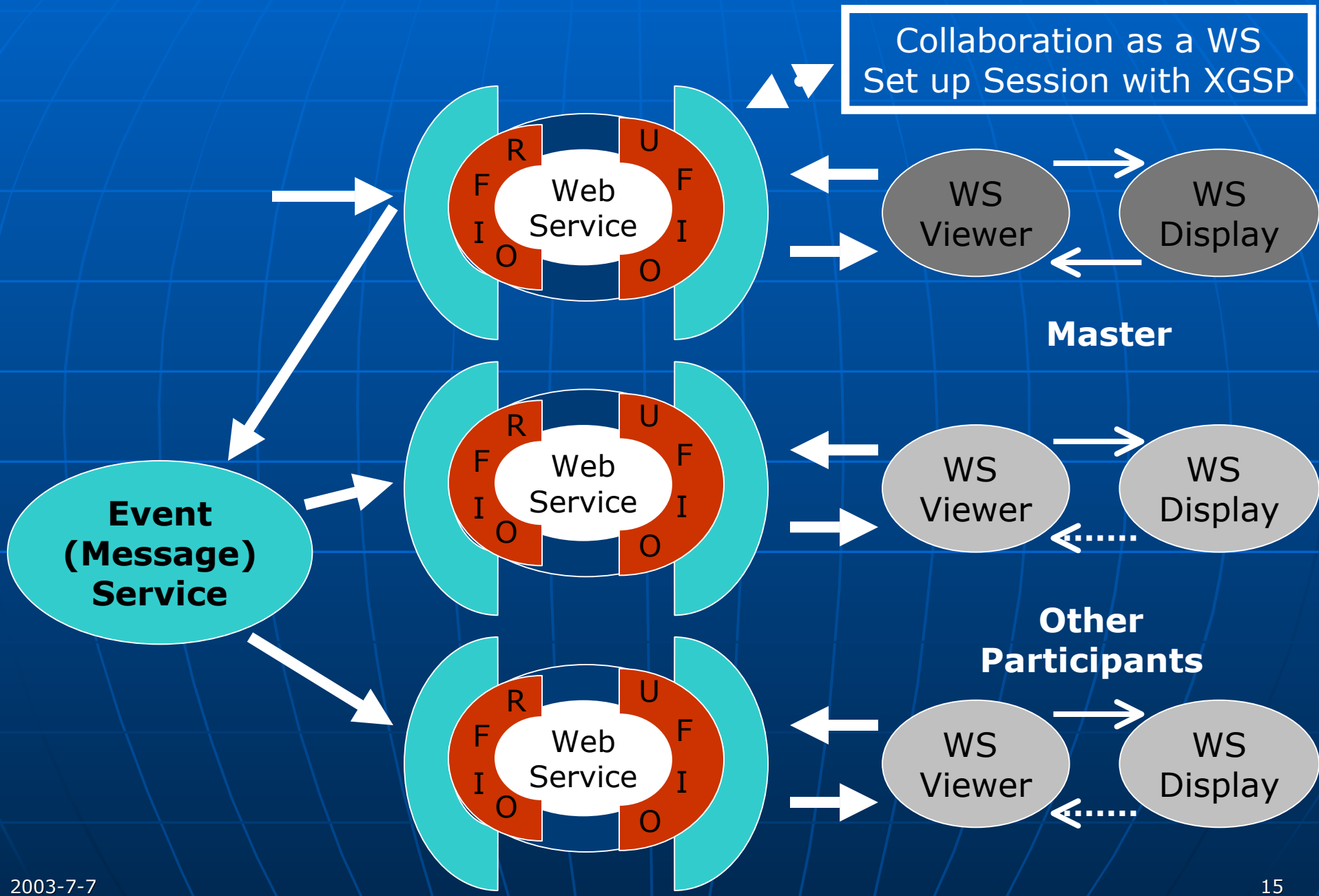
- **XGSP should provide:**
  - **Floor control primitives, including:** *request floor, release floor, grant floor, cancel floor, remove floor request*
  - **mediator-controlled floor control: to support the mediator control policy**
  - **Collaboration applications have to define their own roles in the XGSP registration so that the mediator could assign the role of the application to each user.**

    for example, a shared PowerPoint application should define master/slave role.

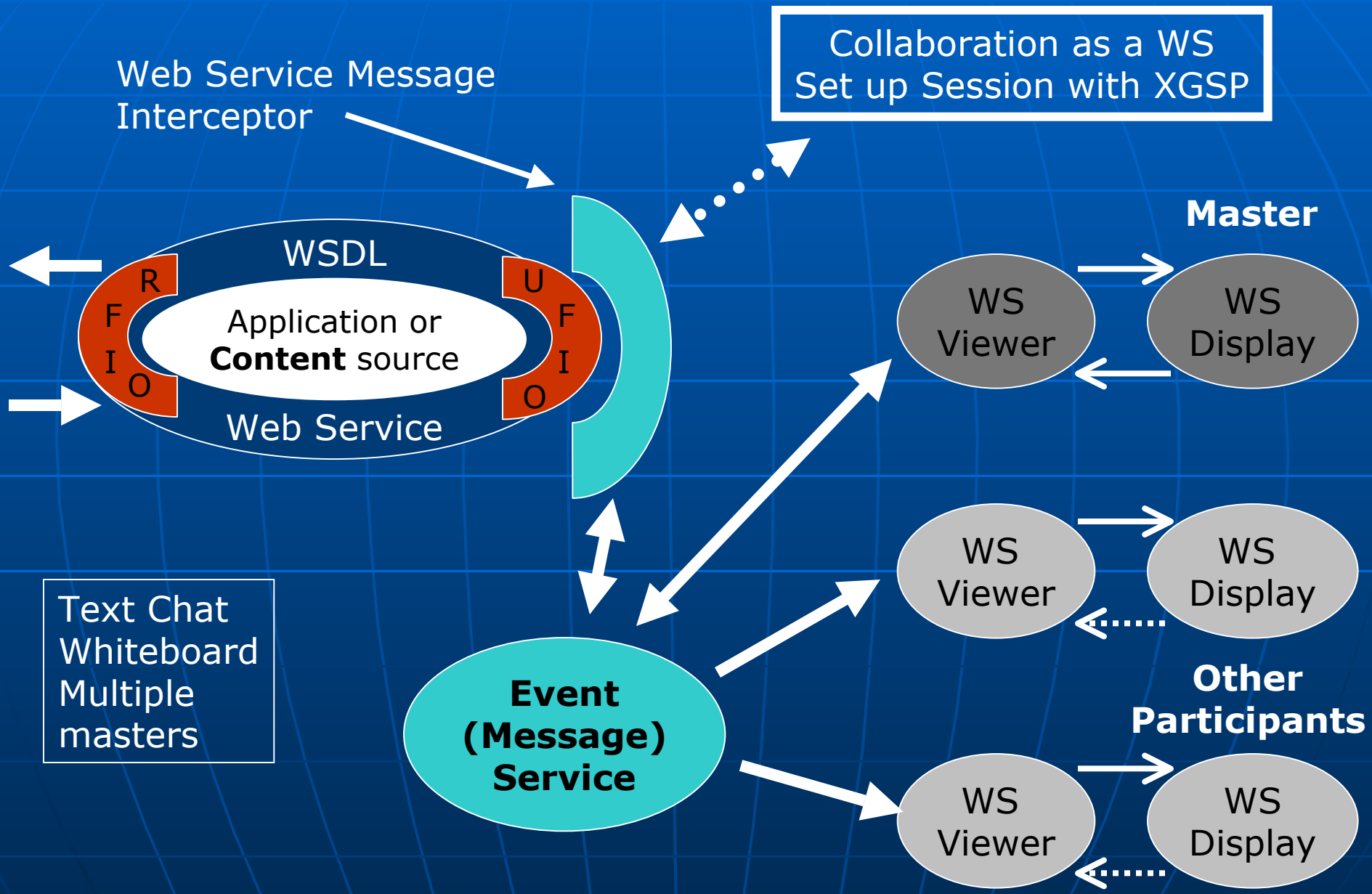
Collaboration Web services System



Shared Input Port (Replicated WS) Collaboration



Shared Output Port Collaboration



Collaboration service → portlets

- Portlets are collaboration components which implement "RFIO" and "UFIO" web services interface
- A portlet provides a presentation logic for user interface
- A portlet can be downloaded and instanced when a user joins the conference
- Each portlet provides client-side services to the XGSP portal for application session management and floor control.

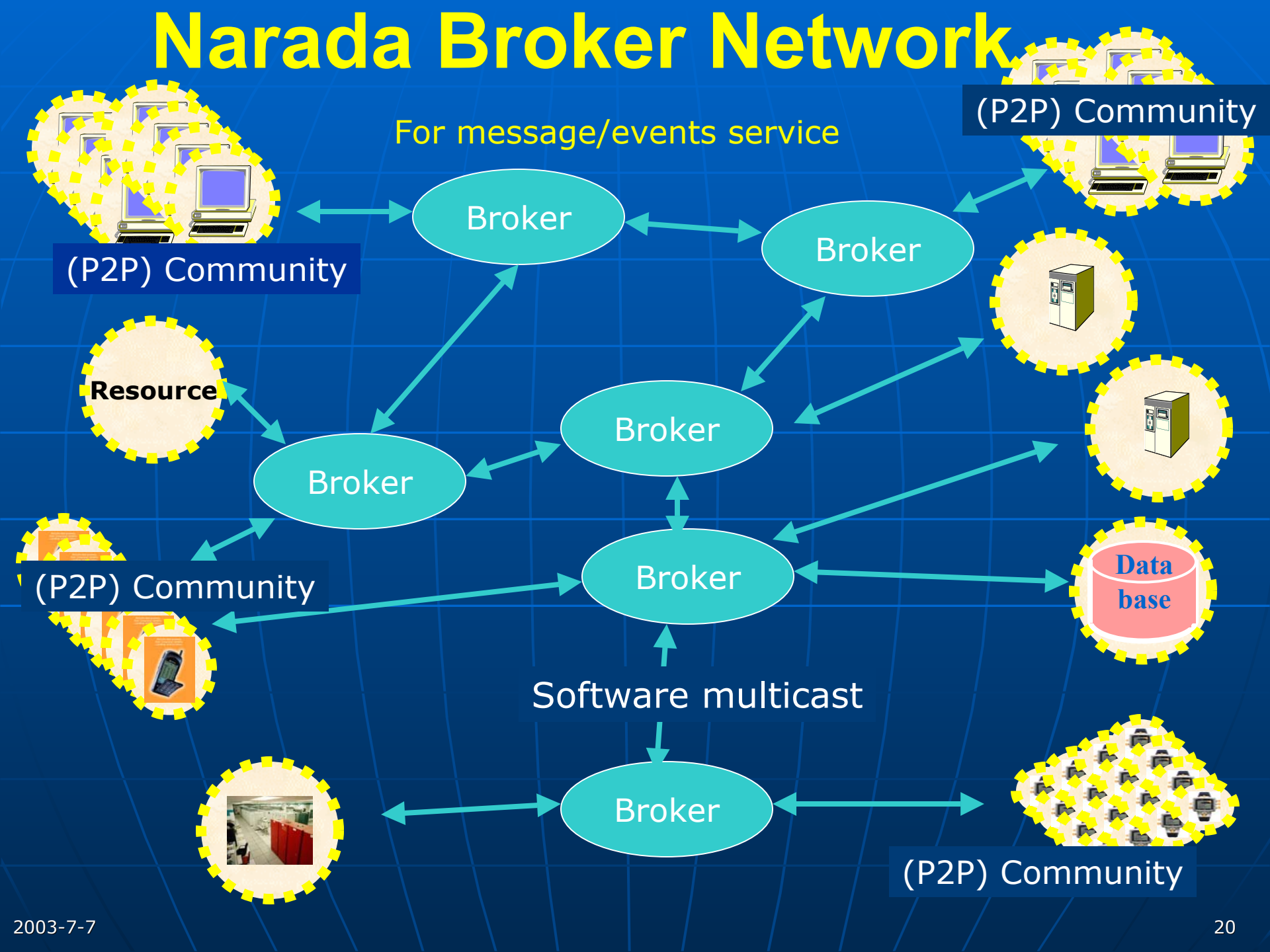
XGSP Collaboration Portal

- **XGSP collaboration portal**
  - *The aggregation of different collaboration services*
  - *The portal is a container of various collaboration portlets*
- **Advantages:**
  - *XGSP users can customize their collaboration portals by adding, removing collaboration portlets and changing the layer out of the portals.*
  - *It is very easy to integrate various collaboration services such as A/V, whiteboard, shared display in XGSP framework.*
  - *Other Grid portals can reuse these collaboration portlets for their purposes*

NaradaBrokering

- Based on a network of cooperating broker nodes
  - Cluster based architecture allows system to scale to arbitrary size
- Originally designed to provide uniform software multicast to support real-time collaboration linked to publish-subscribe for asynchronous systems.
- Now has five major core functions
  - Message transport (based on performance measurement) in heterogeneous multi-link fashion
  - General publish-subscribe including JMS & JXTA and support for RTP-based audio/video conferencing
  - Distributed XML data-base using P/S XPATH metaphor
  - Filtering for heterogeneous clients
  - Federation of multiple instances of Grid services as illustrated by JXTA peer-group linkage

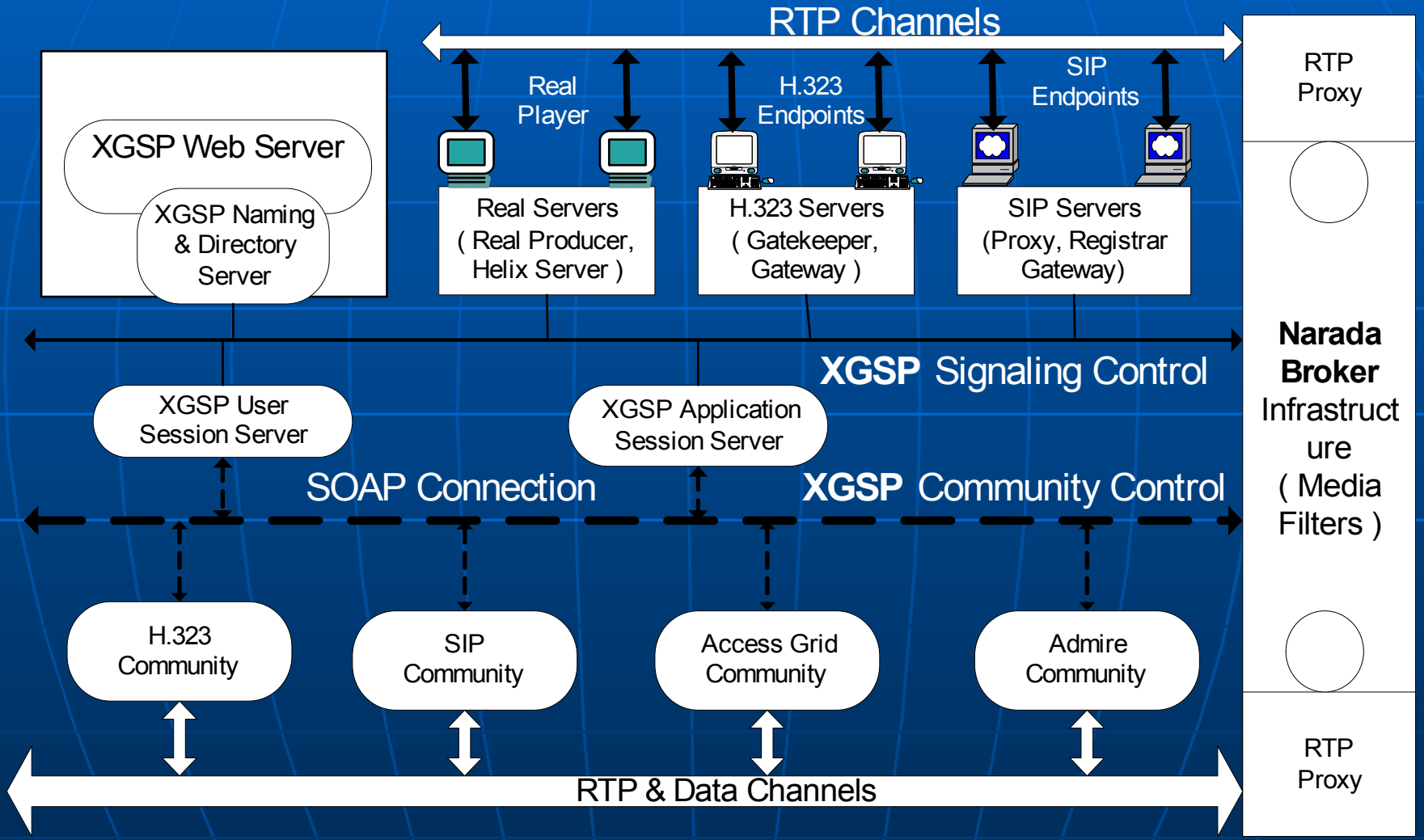
Narada Broker Network



Advantages of deploying NaradaBrokering for XGSP group communication services

- **Covers the heterogeneity of network transportation and provides unified multipoint transportation API**
  - ***Software multicast***
  - ***Communication over firewalls and proxy boundaries***
  - ***Communication over multiple transports***
  - ***Application level Quality of Service***
    - ***Filter messages to slow (collaborative/real-time) clients***
- **Provides robust, scalable and high efficient multipoint transportation services**
  - ***Availability and scalability***
  - ***Efficient routing and bandwidth utilizations***

Global-MMCS Prototype System

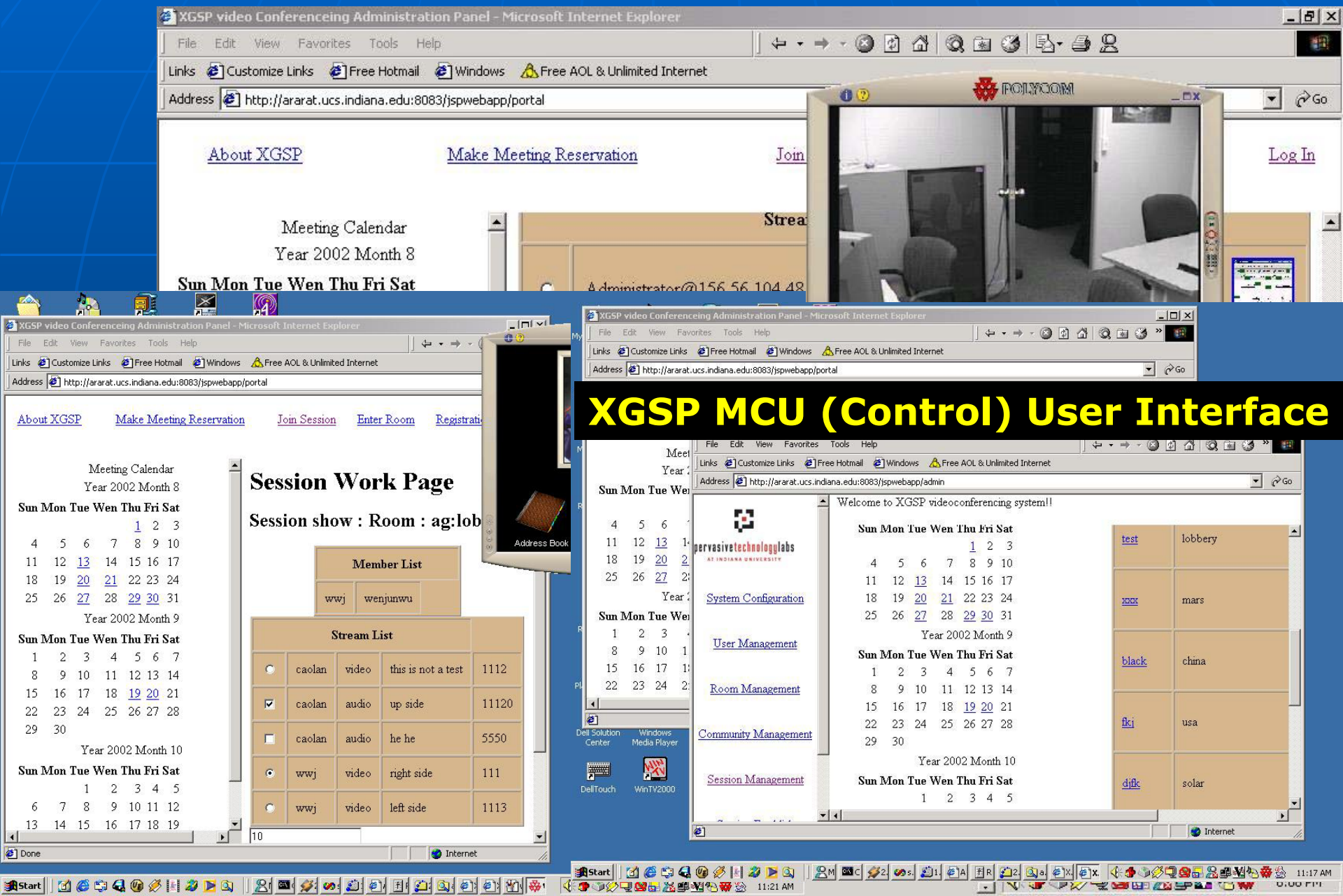


Global-MMCS 1.0

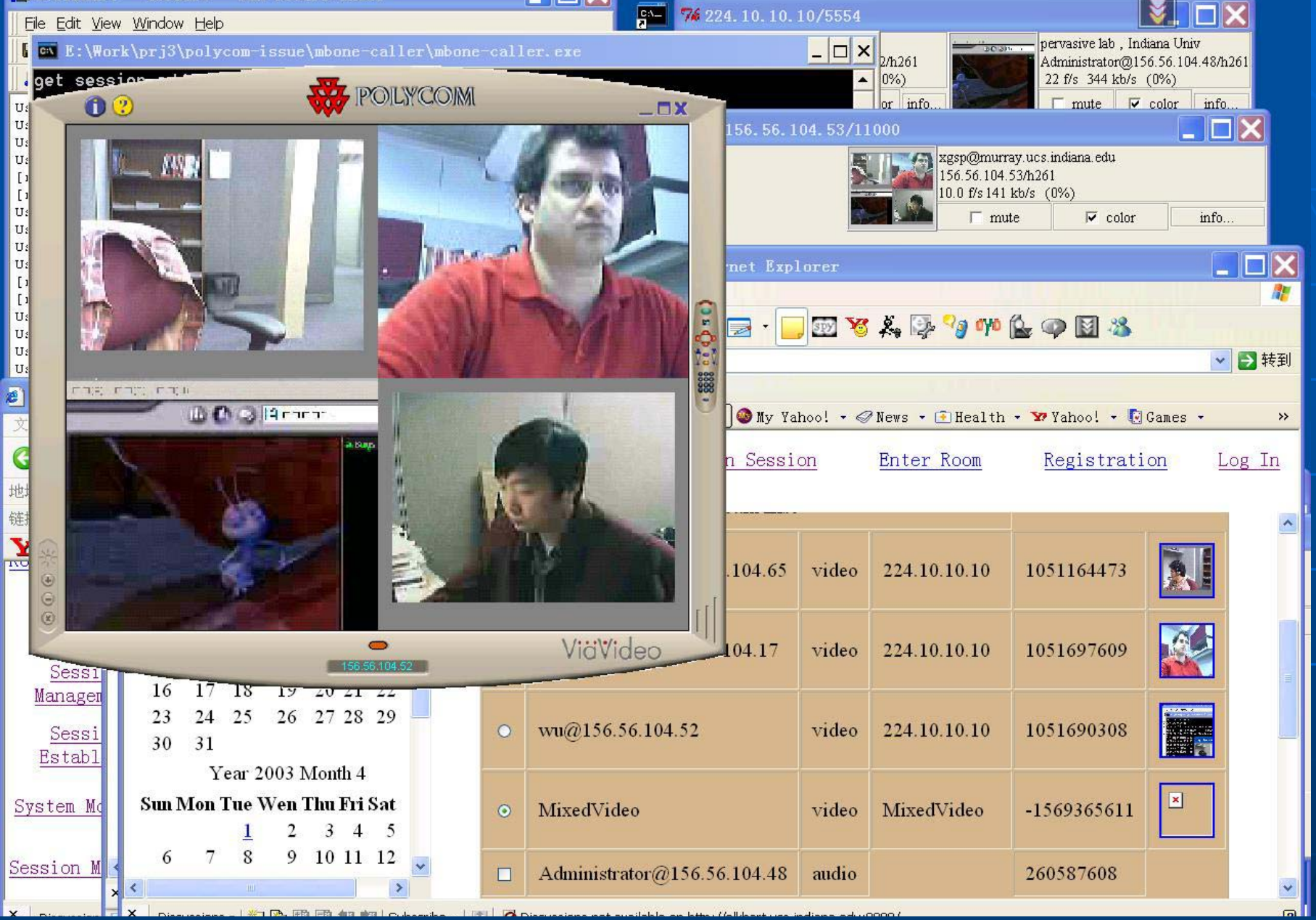
The first prototype of this system includes:

- **A XGSP media server**
  - *provides the services of bridging multicast and unicast, video-switching, video-mixing and audio-mixing to H.323, SIP as well as AG endpoints.*
- **H.323, SIP and Real Servers for A/V clients**
- **XGSP A/V Session Server**
  - *manages real-time A/V sessions, receiving messages from gateways and the web server, and performing appropriate actions on the media server.*
- **The web server**
  - *provides an easy-to-use web interface for users to join multimedia sessions and for administrators to perform administrative tasks.*

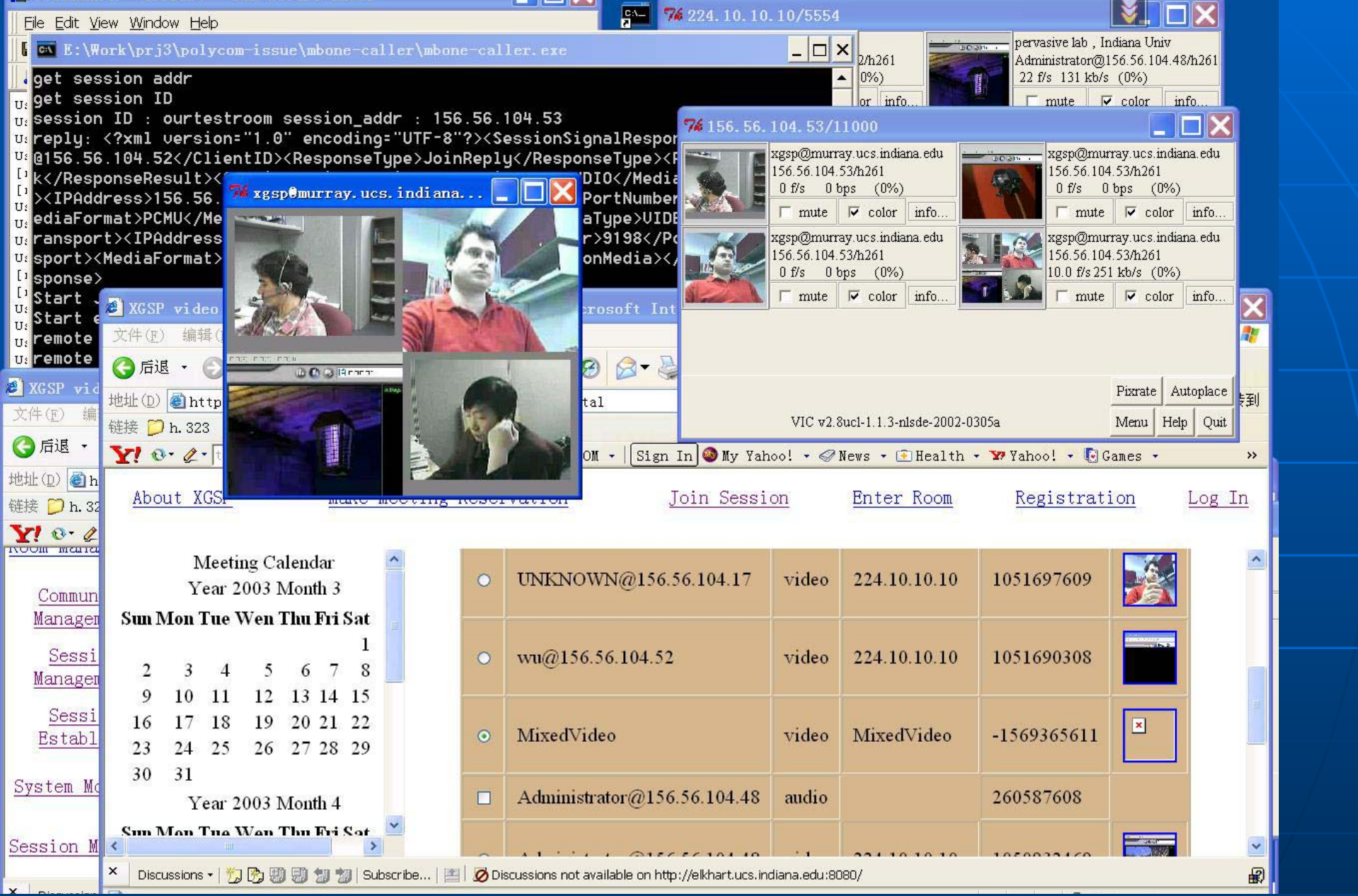
H323 Client (Polycom) in XGSP Session



vic and RealVideo views of multiple streams



Polycom view of multiple video streams



vic views of multiple video streams

Performance Test : GlobalMMCS1.0

- **We conducted extensive performance tests on audio and video servers.**
  - **Video**

    The test shows that our video server is capable of supporting 300 clients if there is only one video sender.

    Video Server Machine : *1.2GHz Intel Pentium III dual CPU, 1GB MEM, RedHat Linux 7.3*
  - **Audio:**

    Our tests show that audio server can support 5 concurrent sessions (250 participants in total) without any packet droppings.

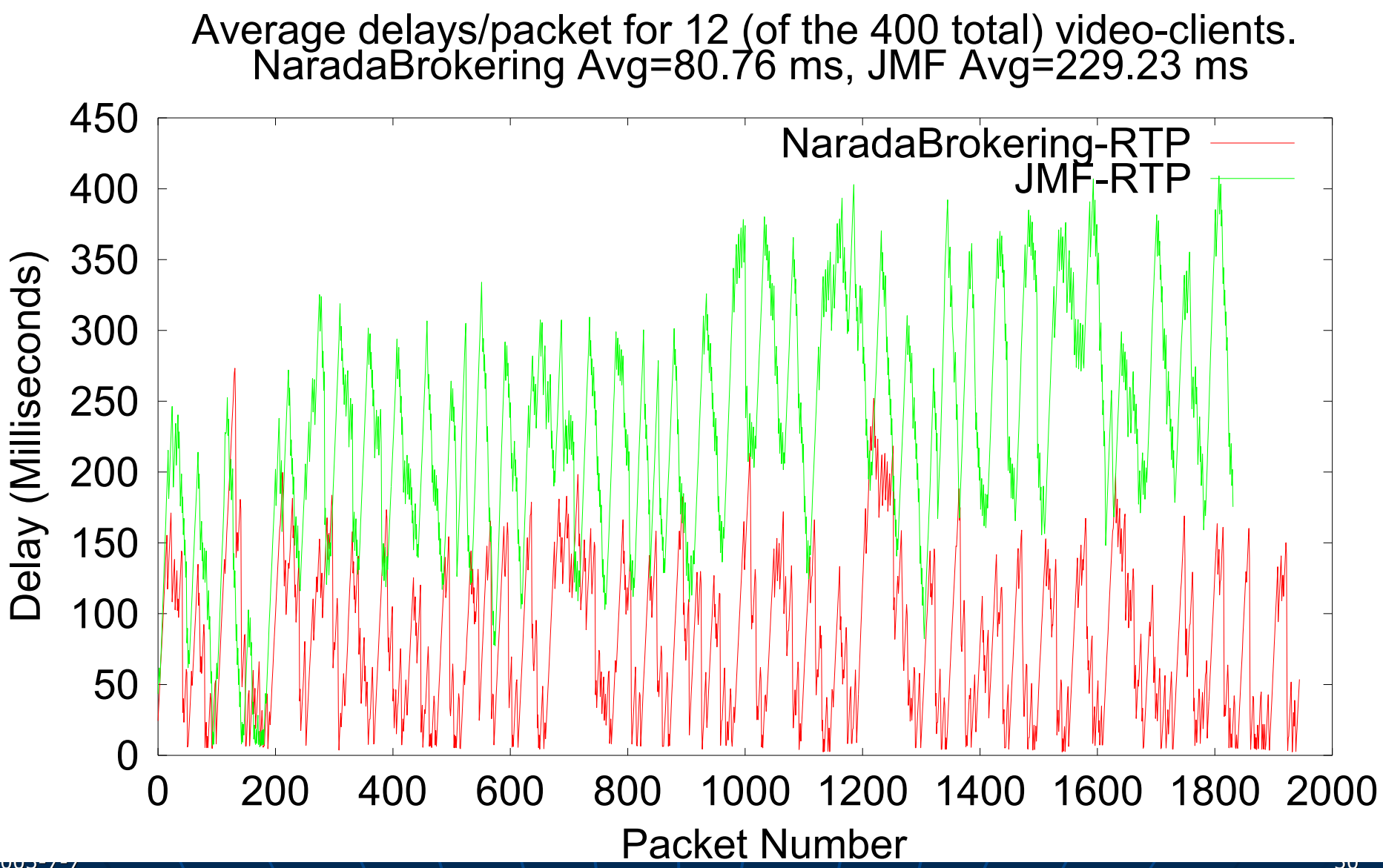
    Audio Server Machine: *2.5GHz Pentium 4 CPU, 512MB memory, Windows XP machine*

Experiences and lessons

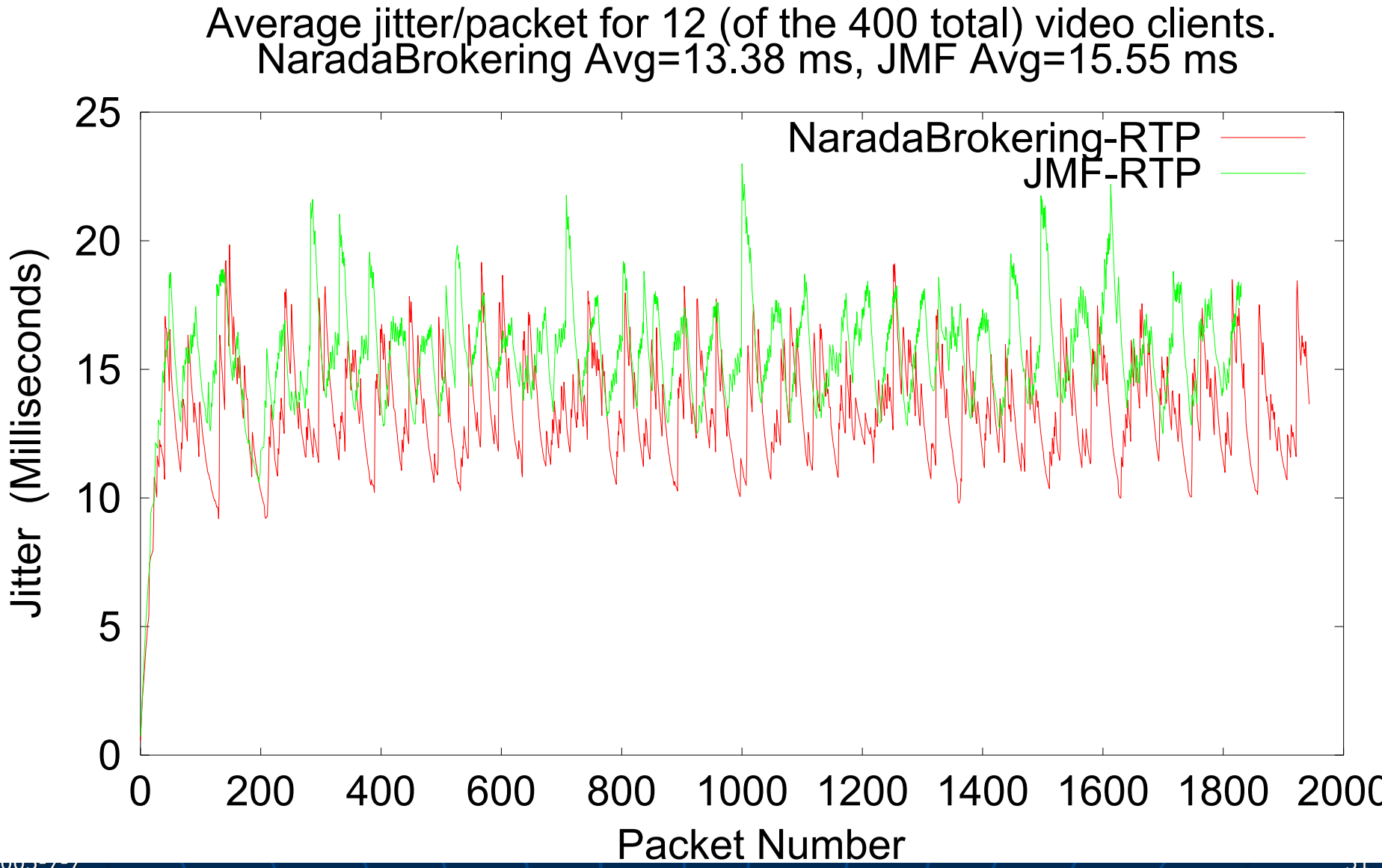
- **A single A/V MCU server is only capable of processing medium scale of videoconferences.**
  Distributed A/V MCU architecture has to be introduced to improve the scalability.
- **Although we build a simple web portal for different A/V clients, it is not easy to enhance it and add more collaboration tools.**

  So we decide to build portlets for different collaboration application tools, and use these portlets to create a powerful collaboration portal.
- **We also test A/V transmission in NaradaBrokering to see whether NaradaBrokering can support high-performance A/V communication.**

Comparison between the performance of NaradaBrokering and JMF



Comparison between the performance of NaradaBrokering and JMF



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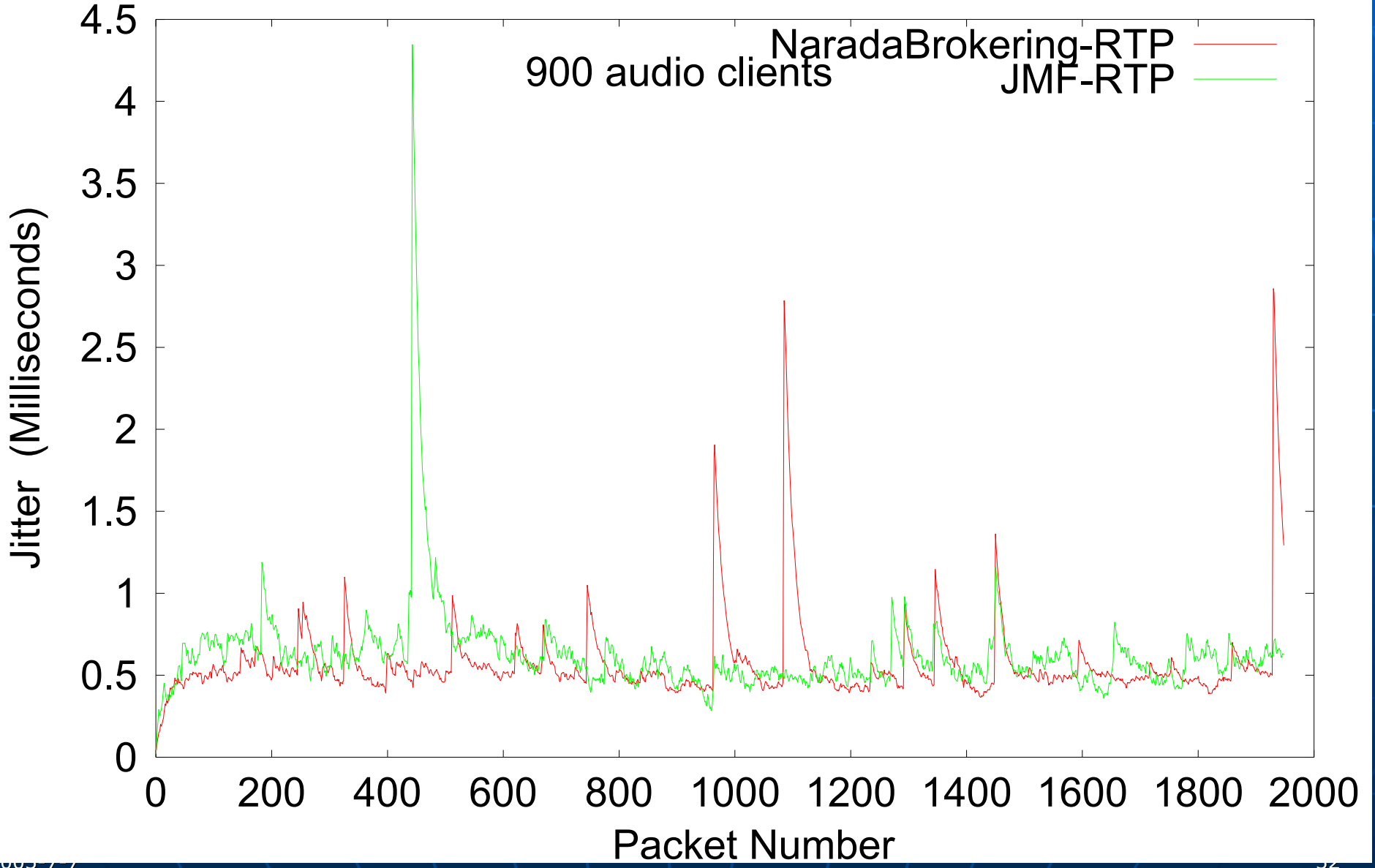
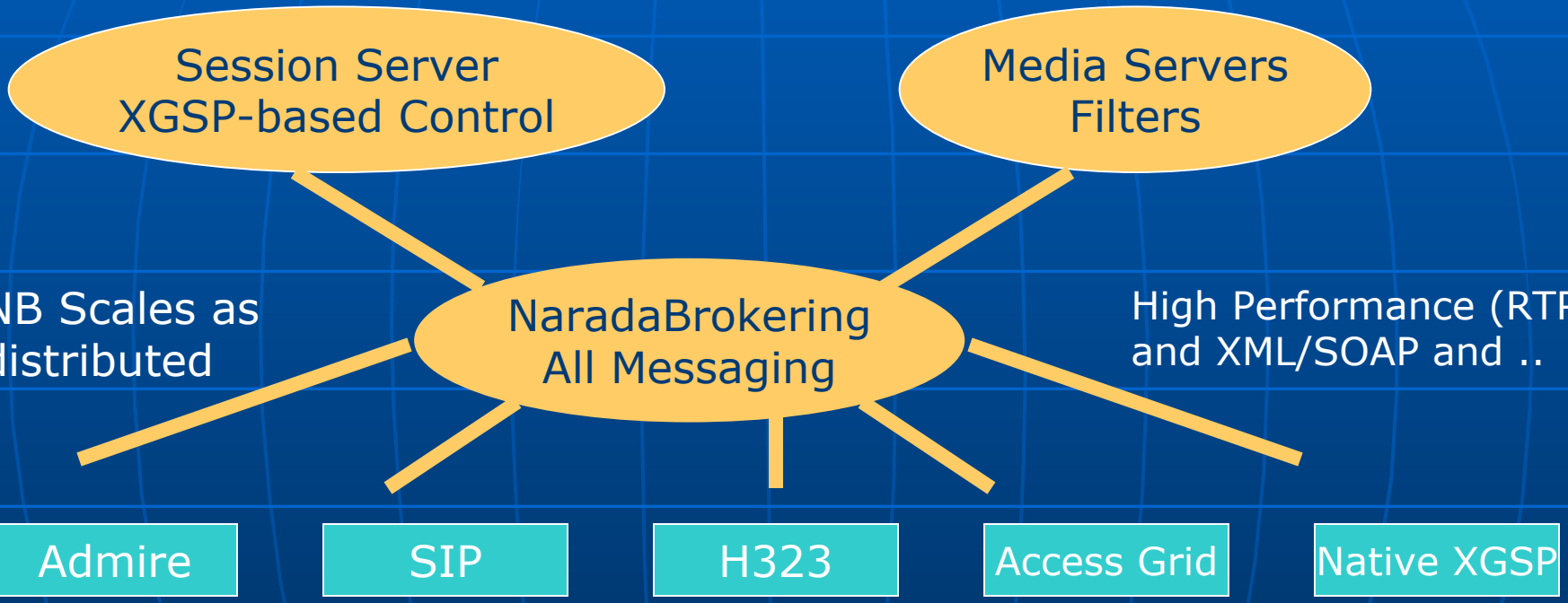


Global-MMCS 2.0 (1) XGSP MCU

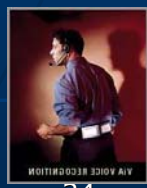
- We are building an open source protocol independent "MCU" which will scale to an arbitrary number of users and provide integrated collaboration services.
- We will deploy it globally and test with thousands of simultaneous users later this year.
- The function of the A/V media server will be distributed in NaradaBrokering architecture.
- Open XGSP MCU based on the following open source projects
  - openh323 is basis of H323 Gateway
  - NIST SIP stack is basis of SIP Gateway
  - NaradaBrokering is open source messaging from Indiana
  - Java Media Framework basis of Media Servers

XGSP MCU Architecture

Use Multiple Media servers to scale to many codecs and many versions of audio/video mixing



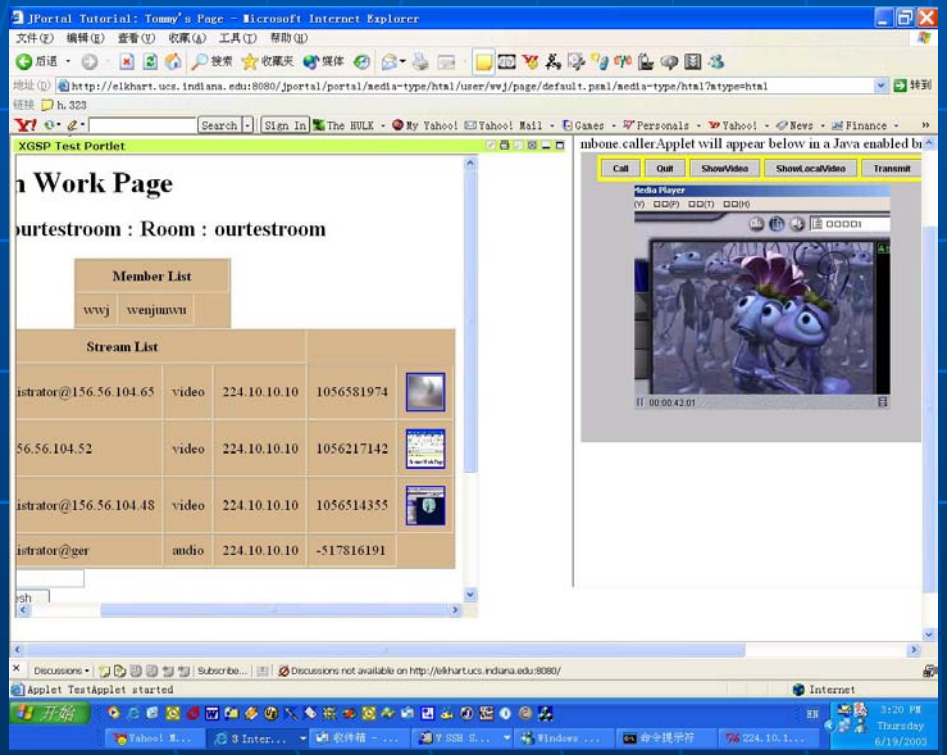
Gateways convert to uniform XGSP Messaging

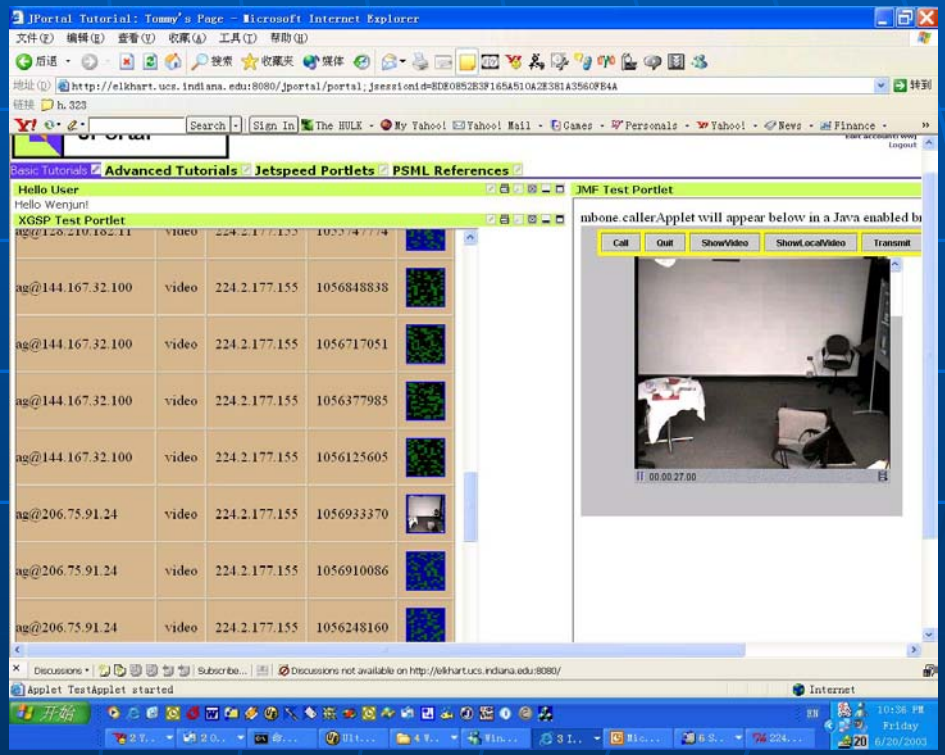


Global-MMCS 2.0 (2) Portlets

- **Collaboration clients will be built into portlets by creating *Java Applet or ActiveX controls* for these clients and adding them into HTML pages.**
- **A collaboration portlet opens local services for XGSP application session management and floor control.**
  - *Node Manager portlet invoke the service to control local portlets*
- ***Apache Jetspeed seems good open source technology supporting this model***
- ***Portlets such as Access Grid portlet can be reused by Grid Portal Developers***

Unicast AG Portlet





Global-MMCS 2.0 (3)

- **Use web services to integrate the communities**
  - **Web-services for Admire in China will be fully implemented in the new prototype.**
  - **Global-MMCS will integrate Access Grid and Admire as well as other H.323 and SIP communities to build a global collaboration platform.**
  - **Make full use of conferencing resource and create larger collaboration communities**

    for example, there is no stable multicast link between China and US, our system can provide a "bridge" for that.

Admire Project in China

- Admire(Advanced Multimedia Interactive Real-time Environment)

  A videoconferencing project in China similar to Access Grid.
- It is deployed in many sites across China and provides audio, video, and data sharing tools.
- Admire also provides "Admire Media Gateway Server" which plays the role of the bridge between multicast and unicast networks.

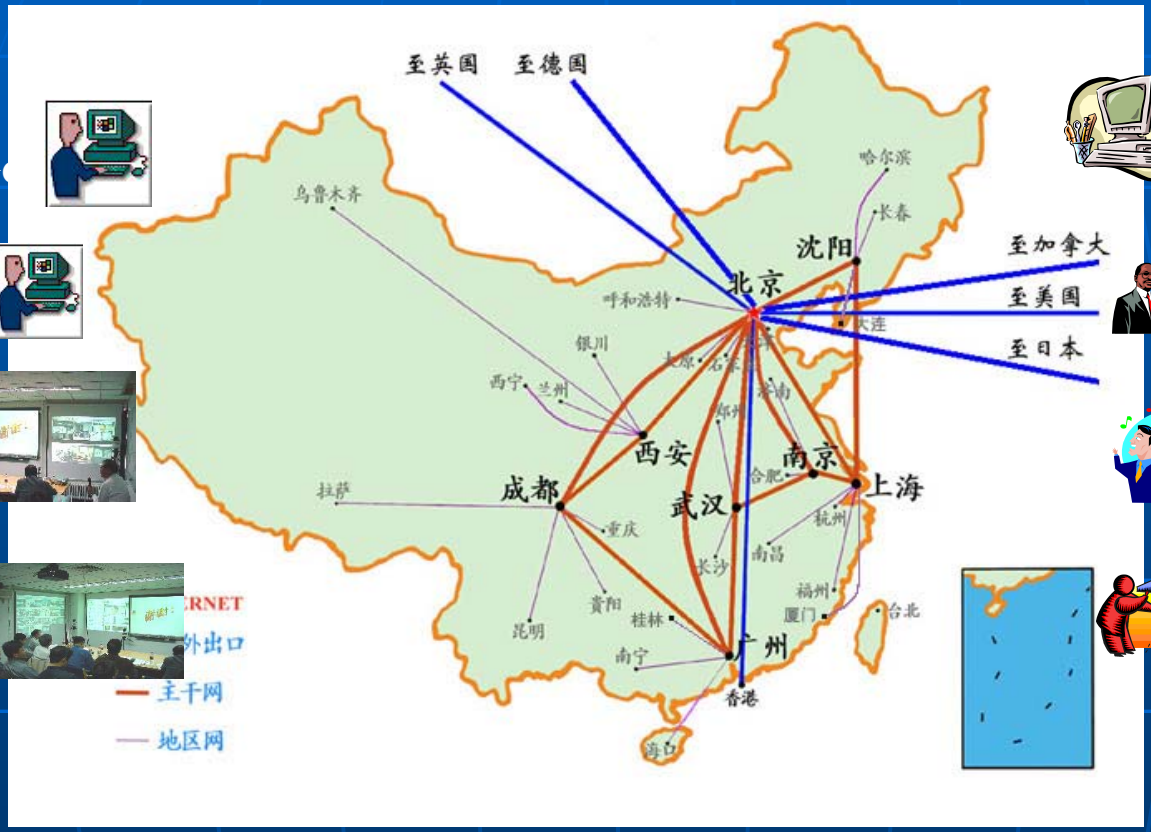
National video conference system for Scientific Research

Administrator,Government

Researcher, Students, …

Remote presentation

Remote seminar



Retrieving Data

conferencing

Site visiting

News Announcement

National conference center/regional access points

Open standard for connecting to “National A/V system for Research”

High speed network environment CERNET

Admire Demo Pictures


安徽省教育厅
安徽省教育厅.视频1
上海市教育委员会.会场
甘肃省教育厅会场
甘肃省教育厅.视频1
广东省教育厅
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广东省教育厅.视频1
福 建 省 教 育 厅
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内蒙古教育厅.视频1
黑龙江省教育厅
黑龙江省教育厅.视频1
AdmireUI 1.3.1.18i
简洁界面
控制台最小化
切换房间
切换AG房间
系统配置
幻灯片配置
电子白板
共享网页
admire
RealCapture
安徽省教育厅
北京教育委员会
北京科技大学
福建省教育厅
甘肃省教育厅
广东省教育厅
广西教育厅
贵州省教育厅
海南省教育厅
河北省教育厅
河南省教育厅
黑龙江省教育厅
湖北省教育厅
湖南省教育厅
麦克风
DVI-mono-16k
屏幕1
屏幕2
视频源
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丢失
带
山西省教育厅.视频1
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安徽省教育厅.视频1
河南省教育厅.视频1
中国人民大学.视频1
广东省教育厅.视频1
北京科技大学.视频1
上海市教育委员会....
屏幕排布
选项
视频全开
视频全关
视频源数目
总带宽
选中
打开
本室成员
<所有人>
fengdl
请求发言
用户可以发言
系统消息：已经跟文本交互服务器连接成功！
系统消息：位于 教育部 节点的 wuqiong 进入 休息室
您现在 进入了 第二会议室
系统消息：位于 admire 节点的 wangtao 进入 第二会议室
系统消息：位于 wangtao离开了会议室
你 说：早晨好！
系统消息：位于 北航 节点的 potato 进入 第二会议室
系统消息：potato离开了会议室
你对potato说：
密谈
发送
用户：wuqiong
节点：教育部
会议室：第二会议室
会议：12日会议
主席：
网关接入
开始
Admire视频会议系统
AdmireUI 1.3.1.18i
9:22


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北京邮电大学
北京中医药大学
清华大学
复旦大学
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周 济
教育部 主会场
北京航空航天大学
上海交通大学
北京中医药大学
北京邮电大学

Integrate Admire into Global-MMCS

- **Goals:**
  - **Access Grid users in USA can communicate with Admire users in China**
  - **H.323 and SIP users can attend the Admire conference**
- **Approaches**
  - **Admire provides XGSP Web Service Interface**
  - **Connect Admire Media Gateway Server with NaradaBrokering infrastructure**

Related work and comparison

- Global-MMCS provides opportunities for those
  - either use H.323 and SIP clients such as polycom, windows messenger
  - only have unicast network and NAT firewalls.
- Compared to VRVS : different focuses
  - open source scalable “MCU” based on messaging middleware
  - integration with other communities
  - portlet for user interface, providing more collaboration tools

Questions?